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From The Author

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On a *peculiar* Bed *of* Angular Drift *on the* Lower-chalk *high* Plain *between* Upton *and* Chilton. By Prof. J. Prestwich, F.R.S., F.G.S., &c.

In making the new line of railway from Didcot to Newbury some sections of considerable interest were laid open between the main Great Western line and the village of Chilton. For the first three miles from Didcot the railway passes over the Upper Greensand, the lower part of which here consists of compact beds of greenish sandstone, and the upper part of beds of a light-coloured greensand, together probably more than 100 feet thick. Beyond these, at Upton, the Chalk without flints rises in a range of hills running east and west, through which the line is carried, exposing a fine section, a mile in length, of drift, Chalk-marl, and Lower Chalk* (see section fig. 1).

The point, however, of more particular interest is the great bed of drift indenting the chalk. It sets in one third of a mile south of Upton, and extends to a short distance beyond Chilton, a length of about 1¼ mile. It is a drift of a character so abnormal in this district that it deserves a short separate record. The tract it occupies forms part of the flat plain which here extends with a width of about two miles from the foot of the escarpment of the Upper Chalk with flints, near East Ilsley, to the edge of the lesser escarpment of the Lower Chalk without flints at Upton, above referred to (see section fig. 2). A small transverse valley here runs through these Lower-Chalk hills; but, though a line of drainage, it is without any permanent brook or stream, nor was there any distinct appearance in the railway-cutting (which at Upton was carried up this small valley) of there having been a stream here in former times.

In the first cutting the Lower Chalk rises bare to the height of 27 feet. The next cutting, which is from 10 to 20 feet deep, is through a white chalk rubble, fine and marly at base, coarser and with a few small angular fragments of flints at top. A little way beyond, the chalk comes up again through the drift, is again replaced by the drift, and again the hard grey chalk rises abruptly to the surface in a cutting 35 feet deep. Thus far the drift is very fine, more like decomposed Lower Chalk, and no organic remains were found in it in this part of the cutting.

Beyond, the characters begin to change; the drift becomes more coloured and somewhat coarser, and occasionally small boulders and bones were met with. A great number of bones were found together about two thirds down in this rubble drift about midway in the Chilton cutting, at the point marked A (see figs. 1 and 3, p. 129). A short distance further southward an intercalated darker clay bed

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* Very few fossils had hitherto been obtained from the Lower Chalk of the Didcot district; but in this cutting they were, in places, abundant, especially *Ammonites varians.* Altogether we obtained 35 species from the Lower Chalk, and 23 species from the Upper Greensand, for the Oxford Museum.

Fig. 1.—*Railway Section from Upton to Chilton.* (Length, 1½ mile. Scale of height, 1 inch = 200 feet.)

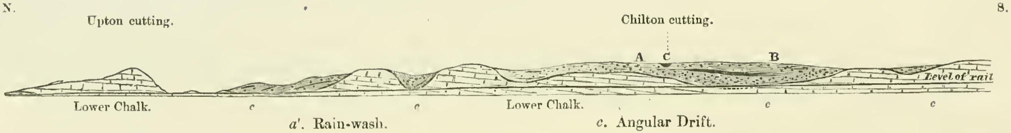
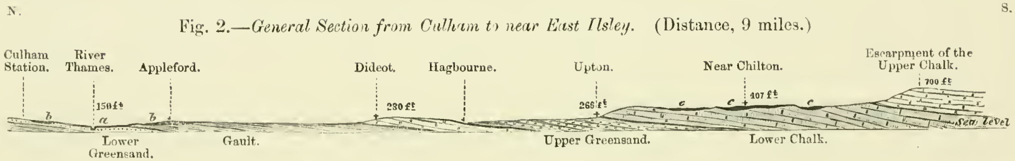


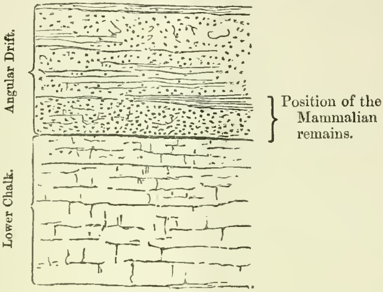
Fig. 2.—*General Section from Culham to near East Ilsley.* (Distance, 9 miles.)



a. Alluvial bed of the Thames.
b. Low-level Valley-gravel, with mammalian remains and river-shells in places.
c. Angular drift, with mammalian remains and land-shells.

set in (see fig. 4, p. 130), and divide the mass into a lower light-yellow coarser angular drift, and an upper whiter and finer drift, but both alike in composition, and both consisting of irregular roughly stratified beds. The works had extended to this point when the discovery of elephant-remains was reported to me.

Fig. 3.—*Section in Cutting at A, in fig.* 1, *enlarged.*



I took an early opportunity of visiting the spot; but the cutting had then gone beyond the place where the bones were found, and the sides were sloped over. The bones proved to be those of *mammoth, rhinoceros, horse, ox,* and *deer.* They were mostly in a broken and fragmentary state. But, though broken, they are not rolled or waterworn. The state of preservation of some of the bones is very remarkable; they have lost so little of their animal matter that the bone hardly adheres at all to the tongue, and looks almost as fresh as a recent bone. Dissolved in dilute hydrochloric acid, they leave a mass of flocculent gelatinous matter. This is more especially the case with some of the Bison bones, one of which comes from near the base of the cutting at point B (fig. 1)*. The specimens now in the Oxford Museum consist of—

Elephas primigenius	Some fragments of large bones.
Rhinoceros	Distal end of femur and other bones, all broken.
Equus	Teeth and fragments of bones.
Bison priscus?	Right metatarsal, distal end of metacarpal, left humerus, and right tibia.
Cervus tarandus	Tooth and fragments of antler.

But a larger number have been found, including portions of two lower jaws and of tusks of Mammoth, teeth of Horse, end of humerus and 4 teeth of *Rhinoceros tichorhinus,* fragment of horn of Red Deer,

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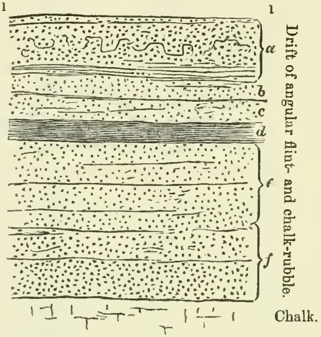
* A recent analysis of this specimen on the chemical side of the Museum shows this bone to contain 17·35 per cent. of organic matter. Recent bones of Ox contain about 30 per cent. Mr. Fisher also informs me that the bone contained a notable proportion of manganese.

4 teeth of Bison, and some undeterminable fragments. There are no traces of gnawing on any of the bones.

When I first visited the cutting the drift-exposure was at its deepest, extending to the base of the cutting, a depth of 28 feet, and ust reaching the chalk beneath. The section it here presented is as under (fig. 4).

Fig. 4.—*Section in Cutting near the village of Chilton, at B, fig.* 1, *enlarged.*



	feet.
1. Surface soil (reddish loam with a few flints)	½ to 1.
a. Cream-coloured fine chalk- and flint-rubble, showing a deeply festooned or waved surface	6 to 10.
b. Soft white marl (reconstructed chalk) with shells	4 to 6.
c. Very light yellow chalk- and flint-rubble (with an occasional black band)	2 to 5.
d. Dark brown clay (almost black in places), forming a line of separation between the lighter beds above and the darker yellow and brownish beds beneath; two specimens of *Pupa marginata*	2 to 4.
e. Light-yellow flint- and chalk-rubble, fine; one *Pupa*	3 to 6.
f. Coarser flint- and chalk-rubble; bone of *Bison*	5 to 10.

In the lower half of the drift there were found irregularly dispersed in various parts of the cutting a few blocks of very hard and compact Sarsen stone (Lower Tertiary Sandstone). Two of the largest measured 2 ft. × 10 in. × 9 in. and 1 ft. 9 in. × 1 ft. 6 in. × 10 in. The angles were rounded; but otherwise they were not much worn.

In the beds *c* and *f* were some grains of glauconite, derived probably from Lower Tertiary sands; and the clay of bed *d* may be derived from some of the Tertiary clays. The black band in *c* is caused by the admixture of a sooty manganese peroxide.

The fragments of chalk mostly vary from the size of a pea to that of a bean. Some, which consist of soft chalk, are worn and rounded; but others, which consist of a very hard chalk, are flat and subangular. There is also a bed of chalk-rubble, in which are angular fragments of soft chalk.

All the fragments of flint, on the other hand, even the smallest (and there are few more than 2 or 3 inches in length), are *perfectly sharp* and *angular,* and are generally not discoloured. Some, however, are slightly whitened. The chalk débris predominates at the north end of the cutting, and the flint débris at the south end.

Few bones were found, except at the first place. They did not seem confined to one bed, though most of them were found in the lower part of the deposit.

There is no trace in any part of this section of stream- or river-action. With few exceptions, where the rubble forms a soft concrete, the whole mass is loose and incoherent like so much shingle. This condition continues to the very base of the section without difference, except that the rubble is there rather coarser and more coloured. Few of the beds were continuous for the whole distance. They generally formed lenticular masses of greater or less extent. It was in an intercalated mass of white marl, or chalk paste, at the south end of the Chilton cutting, and at a depth of from 8 to 12 feet from the surface, that almost all the shells were obtained; but even there they were far from abundant. They consist essentially of land shells; the two exceptions are so rare that they only prove the rule; for *Planorbis albus*, which lives on water-plants and frequents marshes, can pass over land surfaces, while the *Limnæa truncatula* "is nearly amphibious, being more frequently met with out of the water than in it; it is also found in very elevated spots"*. Dr. Gwyn Jeffreys, who has kindly examined the collection, tells me that the species present no peculiar variations.

The following are the species found in bed *b*. In order to show their relative abundance, I have given the total number obtained during some days' search :—

	No. of specimens.		No. of specimens.
Pupa marginata, *Drap.*	226	Succinea oblonga, *Drap.*	11
Helix hispida, *Linn.*	53	Limnæa truncatula, *Müll.*	3
Limax agrestis, *Linn.*	1	Planorbis albus, *Müll.* (young)	1

I met with no fragments of wood, except one derived probably from Tertiary strata.

A short distance further the chalk rose rather abruptly to the surface; but the drift reappeared a quarter of a mile further on, occupying a small shallow hollow, in which it presented no new features, and where no organic remains were met with. As a whole, the drift becomes coarser and more flinty as it trends to this end.

The level of the base of this drift at its northern extremity is 290 feet, and of its top at its southern end 407 feet above the sea-level,—the level of the Thames at its nearest point (Moulsford) being about 140 feet, and that of the Gault plain below Didcot about 160 feet above the sea-level.

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* Jeffreys, 'British Conchology,' vol. i. p. 83

The peculiar features of this Drift are the absence of worn débris indicating prolonged water-action, and of either marine or fluviatile remains; the presence, it may be said, exclusively of the remains of a land-fauna; its high position of 150 to 260 feet above the adjacent river-level; the irregularity of its bedding; and its wide spread, westward towards Hendred, over the adjacent plain. Sections of it are to be seen in places near a pond and in a shallow excavation two miles distant from the cutting; but there are no deep sections.

The only analogous beds to which I can refer this Drift are the heads of angular rubble overlying the Raised Beaches of Sangatte and Brighton. In all three we find similar mammalian remains, the same irregularity of bedding, and the same absence of wear in the component materials; and at Sangatte I found the same land-shells. The only difference is that the Sangatte and Brighton drifts are more flinty and coarser; but that is a feature merely dependent on the circumstance that at both these places the adjacent chalk is the Chalk-with-flints, whereas at Chilton it is the Lower Chalk.

It is a Drift not following any river-course; nor is it a marine Drift, nor a glacial Drift from the northward; but the constituent parts are either all *local*, or else derived from strata immediately southward—that is to say, from the Upper Chalk-with-flints, and from the Lower Tertiary strata which cap the Chalk hills between Ilsley and Newbury. For besides the glauconite grains which, though probably from the Lower Tertiaries, may be also from the Upper Greensand, we have the more certain Tertiary sandstone blocks (Sarsen stones); while from the Upper Chalk we not only have the flints from the Chalk hills of East Ilsley, but abundant harder fragments of the limestone-chalk derived from the thin bed (two to five feet) of chalk-rock lying between the Lower and the Upper Chalk, and which crops out on the slope of the great chalk escarpment one mile to the south of the Chilton cutting.

This Drift is therefore analogous to the great Land-wash or diluvial deposit which I have described as overlying the Raised Beaches on our southern coast and on the opposite coast of France; only here it is inland, and is the only inland case of a Drift so closely resembling the drifts of Brighton and Sangatte that I have met with in the South of England*.

It appears to fill hollows on this elevated chalk plain in a manner rather difficult to account for. The hollows may have been the deep dry combes so common amongst chalk hills, of which the drift has filled up the irregularities and spread also over portions of the adjacent surface. Further, I think it is to the same action that we must ascribe the trail of Sarsen stones which are scattered lower down over the valley of soft Upper Greensand. Although so many of these blocks have been broken up and removed, they are still numerous in and around the villages of Upton, East and West Hagbourne, and in other valleys below the line of the chalk escarpment.

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* There are, however, others, though differently constituted, which I mentioned in a paper read at the last meeting of the British Association at Swansea, but as yet only published in abstract.

There was an entire absence of the oolitic débris and of the quartzite pebbles which formed so large a proportion of the old valley- or river-gravels.

To show the relation which this angular drift bears to the subangular river-valley gravels, I have given a general section of the country from Culham Station to the summit of the upper chalk escarpment near East Ilsley (fig. 2). The independence of the two drifts will be apparent from this section. In the Thames valley, and at levels of from 10 to 20 feet above the river, a large number of mammalian remains have been found, including specimens of *Elephas primigenius*, *E. antiquus*, *Hippopotamus major*, *Rhinoceros tichorhinus*, *Equus fossilis*, *Bos primigenius*, *Cervus elaphus*, and *C. capreolus*, together with species of freshwater shells of the genera *Pisidium*, *Valvata*, *Ancylus*, &c., and, lastly, *Cyrena fluminalis*, in the old river-gravel.

In the section fig. 1, point *a*′ represents a deposit of "rain-wash" filling a depression some 200 feet in length by 10 feet deep in the centre. It is roughly stratified, consists of a brown clay with carbonaceous bands, and abounds with well-preserved specimens of *Cyclostoma elegans* and *Helix nemoralis*.

In conclusion, I have to express my obligation to the resident engineer, Thomas Scott, Esq., for the levels and a tracing of the cutting.

Discussion.

The President remarked upon the value of this paper as calling attention to a very peculiar form of drift, and inquired if beneath the datum-lines of the railway there were indications of a further extension of this peculiar drift. The occurrence of mammalian bones in so dry a situation was peculiar.

Prof. Hughes said that he had received a few specimens, chiefly of antiquities, from this district, from the Rector of Upton. It appeared to him that there was a kind of rainwash, or subaerial débris, washed into a hollow at the time when the Mammoth lived, and a small pond had at one time been formed in the hollow. One point of interest was the relation of this deposit to the more northern glacial deposits; it was remarkable that there were no fragments whatever, such as were commonly found in the postglacial drifts further north. Did this belong to the period of extreme cold, or of heavy flushes of rain-water at a later time?

Mr. Tiddeman suggested that some other sections of a similar character existed, as on the east flank of the Malvern hills, where was an angular unworn deposit formed of the débris of the hill, and lying at a very low gradient. This, as he was informed by the Rev.

W. S. Symonds, overlay at Malvern remains of *El. antiquus*, *Rh. leptorhinus*, &c. As these remains lay *under* glacial drift at Settle and Raygill, in West Yorkshire, and there was much evidence that the Mammoth fauna survived to a later period than *El. antiquus* and its companions, he thought that the facts pointed to the probability of the beds containing Mammoth and Reindeer, described by Prof. Prestwich, having been formed during a time of heavy and frequent snows, whilst the north-west of England was undergoing glaciation.

Prof. Prestwich in reply described the general section of the neighbourhood; in the lower ground were drifts which contained foreign pebbles, but not so in this upper drift. Whatever was in it had come from the hills above it. He did not think it was rain-wash; it was too coarse and on too gentle a slope for that; a true rain-wash did occur here of quite a different character.